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(6) ANALYSIS
AND
SELECTIVE UPGRADE CRITERIA
FOR
DCS TECHNICAL CONTROL FACILITIES,

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1842 ELECTRONICS ENGINEERING GROUP (AFCS)
RICHARDS-GEBAUR AIR FORCE BASE, MISSOURI

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This technical report has been reviewed and is approved for publication and distribution.

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A Technical Control Facility is a control organization within the Defense Communications System. Standardization is a desirable objective within this complex. However the technical control field has had standardization problems. In order to assure a maximum return for invested dollars and still provide a degree of standardization, a means of determining to what extent a technical control facility requires upgrade or replacement is required. This guide is intended to highlight those areas of the TCF which (over)

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20. require attention to bring them up to a common level of performance and standardization.

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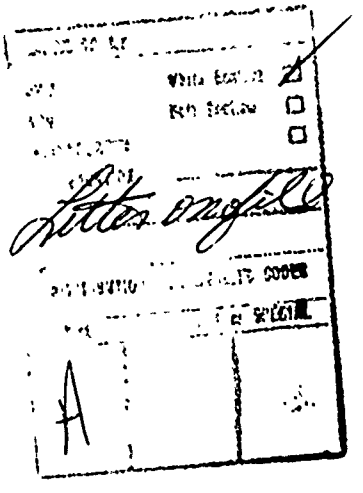


1.0 INTRODUCTION

1.1 A Technical Control Facility is a control element within the Worldwide Defense Communications System (DCS). The DCS is large, complex, and worldwide in scope. To accomplish its communications mission, it is necessary for all parts of the system to operate using the same standards; applied alike to equipment, circuits, maintenance, training, measurement and layout.

1.2 In this large, complex communications network, there may be many routes over which a single communication circuit may travel. These paths are subject to a degradation from many sources - including fluctuations in the propagation medium, unstable power, communications equipment failure, storm damage and other troubles. In order to provide high quality service, circuit performance must not be allowed to fall below an acceptable level. The best way to maintain the quality is to make certain that all the elements which contribute to the functioning of the communications circuits are operating at a common high performance level. By ensuring that, for example, equipment with a similar standardized good performance level is used at each link in the circuit chain, it is possible to discount equipment failure as a source of circuit degradation. By ensuring that circuit levels, circuit conditioning and

circuit impedance matching, are all up to operating standards, circuit characteristics can be discounted as a source of degradation. By ensuring that operating techniques are standardized in all Technical Control Facilities, it is possible to discount improper operation, patching, etc., as a source of degradation. By ensuring that all personnel in TCF's over the world have standardized training, operations and maintenance will be on a reasonably similar high level with a minimum of conflict and inefficiency because of lack of understanding and confusion of terms and techniques among personnel. Even standardized layout contributes to efficiency, for when personnel are transferred from one location to another, no time is lost in familiarization when similar layouts are encountered.

1.3 The technical control field, however, has had standardization problems. This does not mean that attempts have not been made toward standardization, but rather problems have been generated by growth, changes, and advances in technology in military communications. Existing tech control programs, operational directives, manpower and military standards have all been geared towards the problem of "standardization." The latest effort was the World Wide Technical Control Improvement Program (WWTCIP) which was to completely update and standardize the tech control facilities. This type effort had not been accomplished since the tech control "Quick Fix Program" installed

during the 1957-1964 time frame. Originally this manual upgrade was a contractual effort which was recently cancelled due to funding problems. Therefore, our facility standardization problems still exist and an overall AFCS effort is now required to redefine "what" and "how" to upgrade the tech controls using our organic resources. This restructured program has been designated the Manual Technical Control Improvement Program (MTCIP).

1.4 In order to assure a maximum return for invested dollars and still provide a degree of standardization, a means of determining to what extent a facility requires upgrade or replacement is required. The guidelines that follow are intended to highlight those areas of the TCF which require attention to bring them up to a common level of performance and standardization.

1.5 The requirements for new equipment or subsystems being installed are necessarily more demanding than those for already installed subsystems. However, when existing equipment falls below pre-established limits it must be replaced.

1.6 Based on the rationale presented above, the following guide has been developed. There are three basic questions one must ask when evaluating and planning a selective upgrade of a given technical control facility.

1.6.1 Is there sufficient equipment at the facility to accomodate existing and programmed mission requirements (TCF capacity)?

1.6.2 Is the equipment arranged, configured or layed out in the best possible electrical and physical configuration (i.e. floor plan, circuit wiring, TCF layout)?

1.6.3 Is the equipment on site technically sound; i.e., supportability, MTBF, operational capabilities (TCF Subsystem Standards)?

1.7 The answers to the above questions provide the basis for determining the extent of upgrade of a given TCF. This upgrade may range from the simple addition of some interbay trunk jack modules, to the complete replacement of the TCF.

1.8 Specific criteria for answering each of the three questions is provided in three separate sections 2, 3, and 4 respectively.

1.9 Before proceeding directly into the specific criteria, a definition of what sybsystems and equipments constitute a TCF is in order. Below is a breakout of the subsystems and equipments associated with tech control grouped into three areas. Appendices A and B provide a further description of a TCF by providing a block diagram interconnect drawing and a list of major equipments by subsystem, respectively.

1.9.1 The TCF Operations Area consists of the following subsystems and equipments:

A. VF Primary Patch

B. DC Primary Patch

C. VF Equal Level Patch

D. DC Circuit Patch

E. Alarm Bay

F. DC Test Bay

G. Cable Test Bay

H. QATC

I. Orderwire/Intercomm Panels

J. TTY Orderwire

K. Wideband Patch

L. Coordinating and Reporting Position

1.9.2 The TCF Equipment Area consists of the following subsystems and equipment:

A. VF Conditioning

B. DC Conditioning

C. Signal Power Supplies

D. Orderwire Common Equipment

E. Grounding

F. ATEC

1.9.3 Equipments associated, with, but not ccnsidered part of, the TCF are:

A. DC Mux (VFCT, Modems, etc.)

B. VF Mux

C. Radio

D. Technical AC and DC Power

2.0 TCF CAPACITY

2.1 Programs.

2.1.1 Before any evaluation of the existing commences, data on the future of that TCF must be obtained. Information is available from many and varied sources.

2.1.2 A query by NCA to HQ AFCS, the cognizant Comm Area and subordinate units should ascertain any programs which will affect the location in question.

2.1.3 For each program identified the following information must be provided:

A. Program Title

B. Source Document

C. Implementation Time Frame

D. Number & Type of Long Haul Circuits (i.e., DCA Mux Plan)

E. Number & Type of Local (on base) Circuits

F. Other impact on the TCF. (Floor space, power, etc.)

2.1.4 From the above information, a projection of the total TCF equipment required to support those programs must be made; any assumptions or estimates used should be clearly annotated so that as more specific information becomes available the impact can be evaluated.

2.1.5 Once this has been accomplished the following specific requirements can be considered:

2.2 Capacity of Patching. (See Table 1)

2.2.1 The purpose of the following evaluation is to determine if the existing patching facilities have sufficient capacity for the existing circuit requirements and to determine its expansion capacity.

2.2.1.1 The primary patch (cable patch) bay must have sufficient jack sets for all on-base users in the station, both VF and DC.

2.2.1.2 The primary patch (cable patch) bay must have sufficient jack sets for all military and commercial off-base cable circuits, both VF and DC. (Including designated operational spare cable pairs).

2.2.1.3 The primary patch (cable patch) bay must have sufficient jack sets for all tactical interface requirements.

2.2.1.4 All active and spare VFCT channels must appear on the DC Circuit Patch.

2.2.1.5 All active VF circuits and spare VF channels must appear on the equal level patch (VF Patch).

2.2.1.6 All installed spare VF and DC channel equipment shall be provided with a jack appearance.

2.2.1.7 Sufficient jack sets must be provided for all programmed additions to the facility. Transmission system upgrades must consider additional primary jack sets (for added customers) as well as equal level or circuit jack

sets. (Where the exact customer requirements are not known, estimates must be made. These estimates should be based on the proportion of circuits which presently require primary jack appearances versus those that are through circuits).

2.2.1.8 A minimum of 15% spare jack fields over and above existing and programmed requirements (with a minimum of one transmit and one receive jack module) must be available for expansion. (This expansion factor applies only when evaluating an existing capability; new systems and those undergoing major modifications or rehabilitation shall comply with paragraph 4.2.1.1 of MIL-STD-188-310).

2.2.1.9 See Table 1 for a summary of the above requirements.

2.3 Capacity of Conditioning.

2.3.1 Sufficient VF signalling and conditioning equipment must be provided for all existing circuit requirements.

2.3.2 Sufficient DC conditioning equipment must be provided for all existing circuit requirements.

2.3.3 Sufficient VF and DC signalling and conditioning equipment must be provided for all programmed additions to the facility based on program research and estimates.

2.3.4 Sufficient signalling and conditioning equipment must be provided to meet all known tactical interface requirements.

2.3.5 Sufficient signalling and conditioning equipment must be provided to meet all Communications Restoral Plans (CRPs).

2.3.6 A minimum of 10% spare signalling and conditioning equipment over and above existing and programmed requirements must be available for expansion. (This expansion factor applies only when evaluating an existing capability. New facilities will comply with MIL-STD-188-310).

2.3.7 See Tables 2 and 3 for a summary of the above requirements.

2.4 As a result of the capacity analysis conducted, an upgrade decision chart (Figure 1) can be applied to determine the course of action. Basically, once it is determined that expansion is necessary, a determination must be made as to the location of the expansion; then any other deficiencies can be considered.

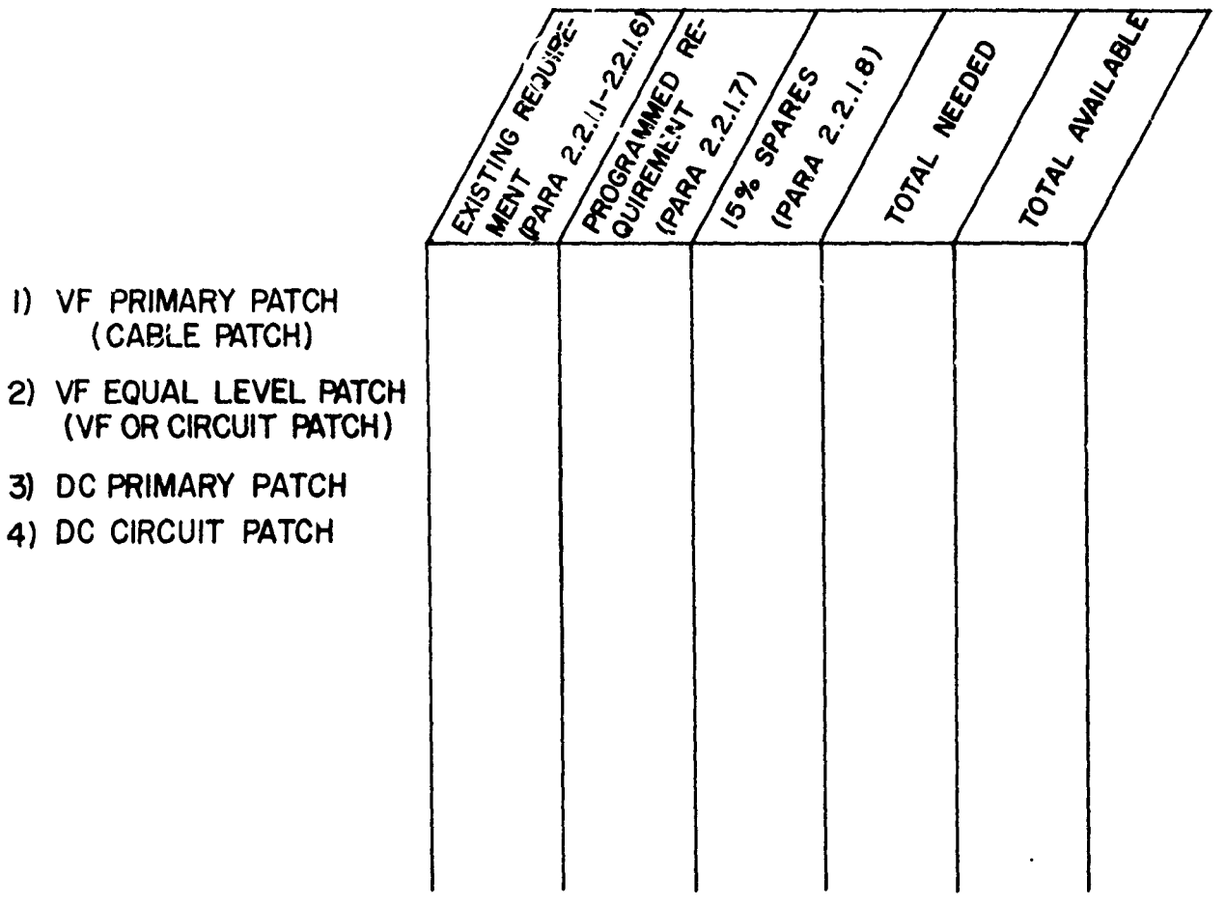


TABLE I
PATCHING CAPACITY

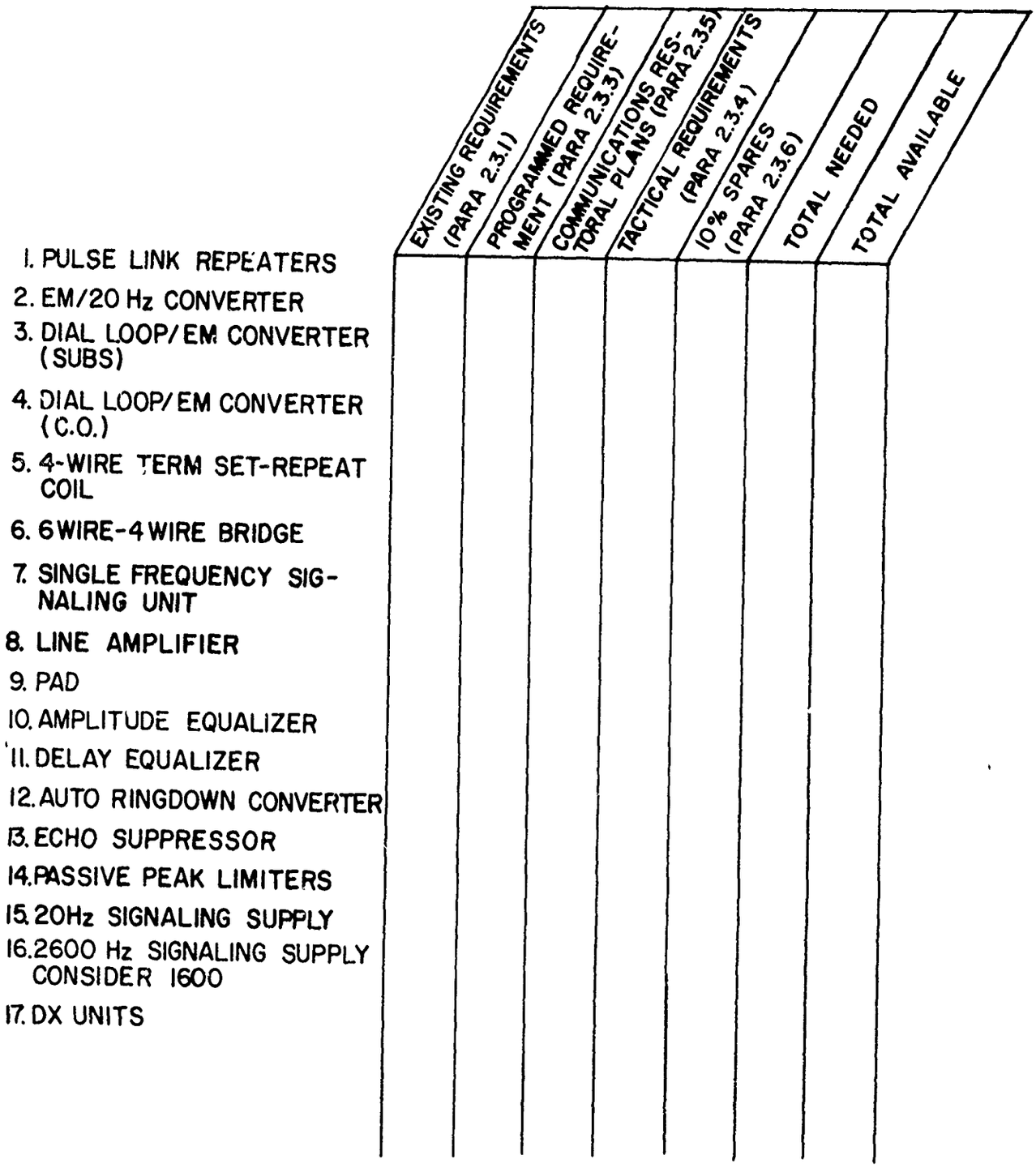


TABLE 2

VF SIGNALING & CONDITIONING

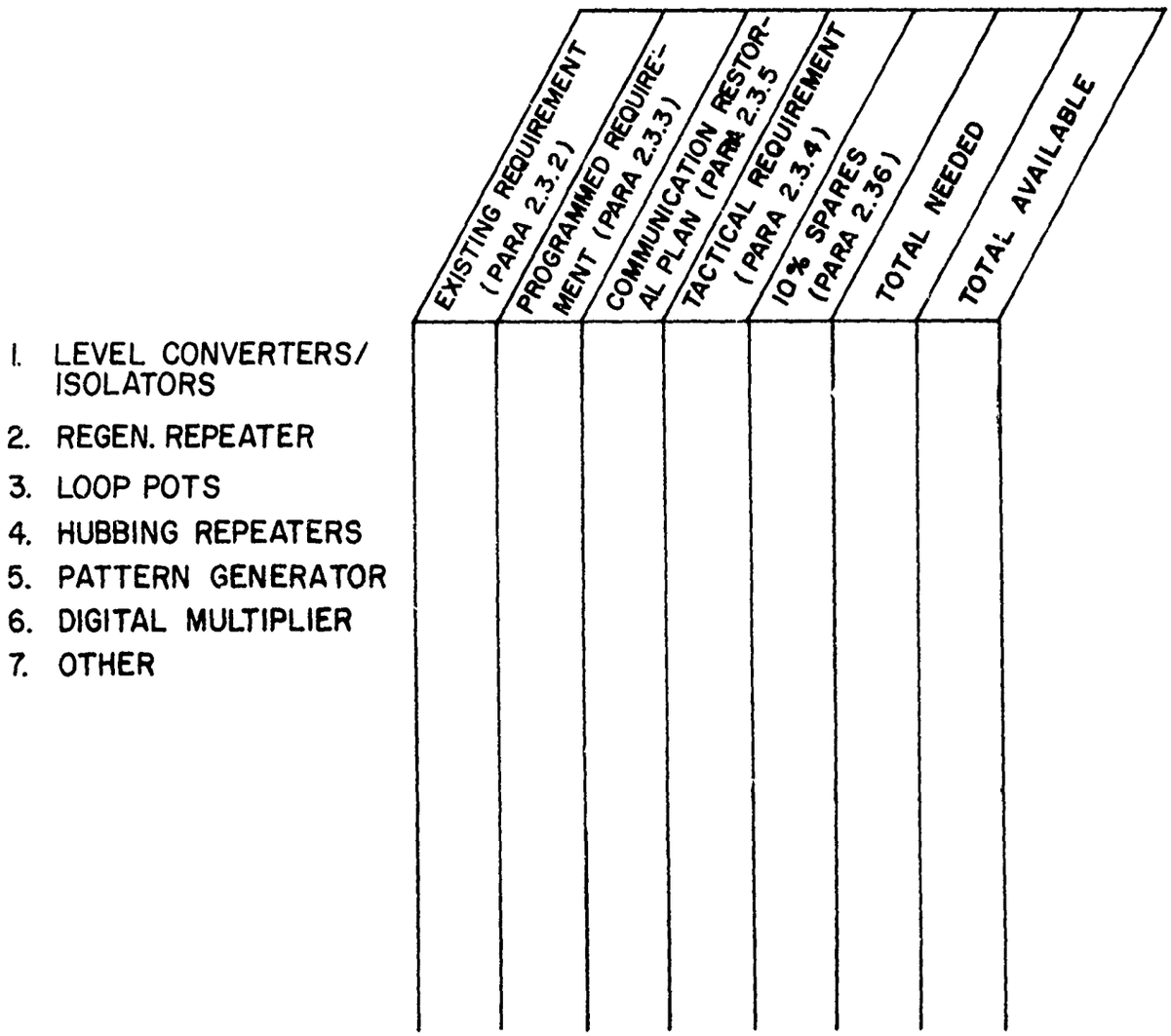
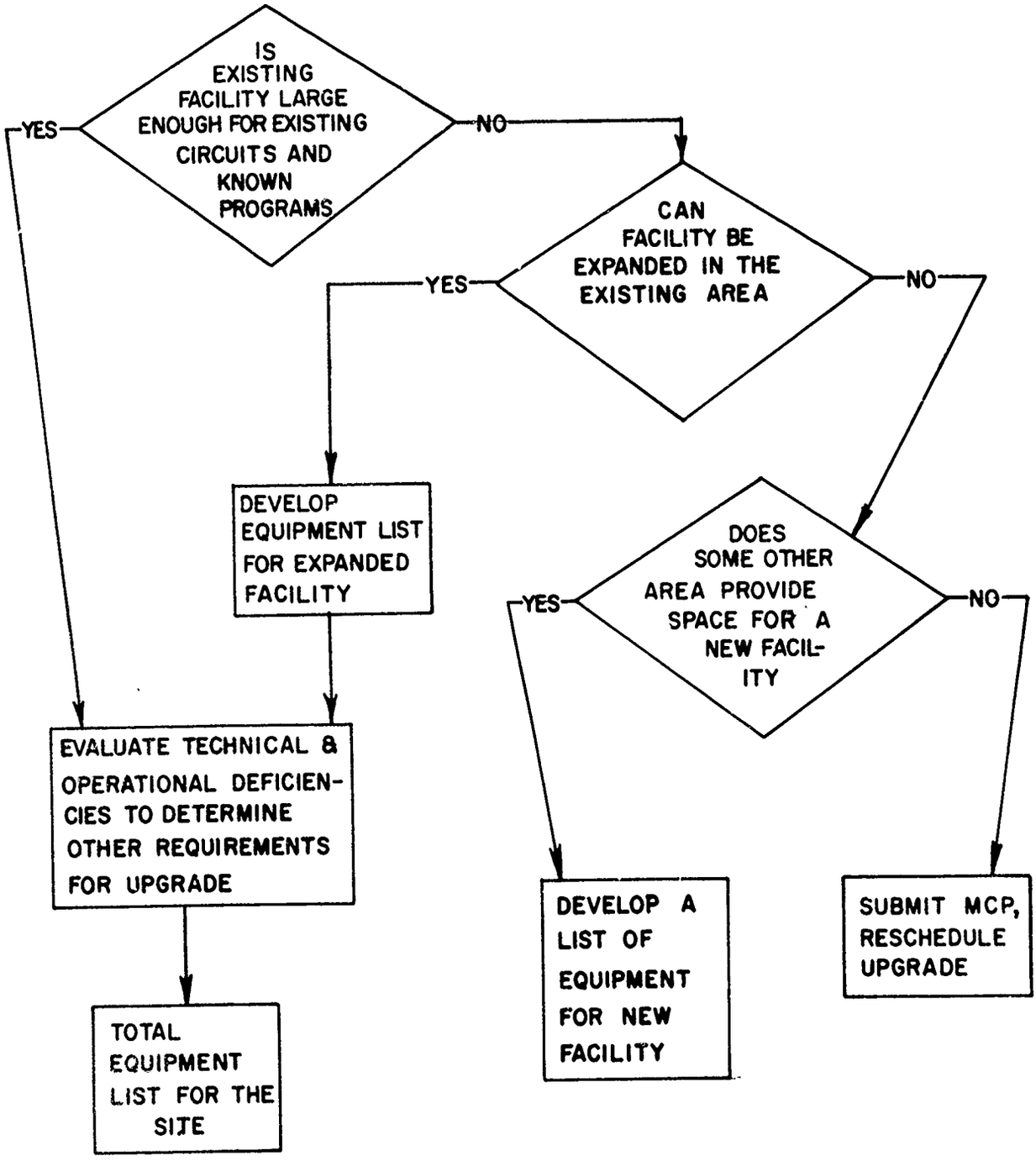


TABLE 3
DC CIRCUIT CONDITIONING



UPGRADE DECISION CHART

FIGURE 1

3.0 TCF OPERATIONS LAYOUT

3.1 The purpose of the following evaluation is to determine the adequacy of the TCF operations layout. The evaluation deals with the physical location of the tools with which the Tech Controller performs his job. It also deals with the physical and electrical accessibility of those tools.

3.2 There should be only one TCF operations location on any base or site. An example of an undesireable situation would exist if separate VF and DC tech control facilities existed on the same base, rather than one combined facility.

3.3 There must be adequate working floor space for the tech controllers in front of patch bay line ups and other equipment cabinets in order to prevent congestion and crowding. (See Appendix C for an idealized TCF Floor Plan).

3.3.1 A minimum clear floor space of 4 feet is required in front of all patch cabinets.

3.3.2 A minimum clear floor space of 6 feet is required between facing lineups of Patch Cabinets and/or test cabinets.

3.4 Test Equipment must be rack mounted. Portable test equipment must be provided with a permanent shelf location including a interface panel to allow access to equipment inputs from a separate jack field.

3.5 Level and noise meters must be available to each VF Patch Bay without the use of interbay trunks.

3.6 Interbay trunk jack sets shall be provided for circuit restoration and access to test equipment in the test center.

3.7 A wideband monitoring and testing capability must be provided within the TCF operations area, i.e. baseband monitoring, group monitoring and patching. This requirement is limited to within 100 cable feet of the multiplex and radio equipment.

3.8 DC test equipment access must be readily available to all DC patch bays. This includes pattern generators, distortion analyzers and oscilloscopes. (See Para 4.3.7.1 for Test Bay requirements).

3.9 TTY orderwire equipment must be located physically close to the associated DC patch and test bays.

3.10 Voice orderwire instruments must be located physically close to associated VF and DC patch and test bays. The Master orderwire instrument should be part of the reporting/coordinating console. Phone cords should not have to extend across clear floor spaces to reach working locations.

3.11 A reporting/coordinating position must be provided having visual access to all working locations within the TCF operations area.

3.12 A Central Alarm display shall be provided in view of the reporting/coordination position.

3.13 Balanced High Impedance (20KΩ) Monitor Speakers shall be provided, as a minimum, one for every five VF patch bays and one for the VF test center. Ideally, one every third bay should be provided.

4.0 TCF SUBSYSTEM STANDARDS

4.1 Multiplex Interface.

4.1.1 While the MWTCIP is not a multiplex program, one of its main objectives is to establish standard interface levels at the multiplex, both VF and DC.

4.1.1.1 In the case of the VF mux the problem is fairly simple. The standard interface sought is a 4 wire circuit at a OTLP using 2600 Hz inband signalling. Many multiplexers in the field, including the AN/UCC-4, can be strapped to operate at a OTLP. Other multiplexers will require the addition of attenuators (pads) on the input and output. Multiplex out-of-band signalling capabilities interfacing with E&M or DC signalling should not be used, but rather equipment provided as part of the VF conditioning and signalling string should be employed. However, signalling units cannot be changed out at only one end of the circuit. Standard signalling equipment will only be provided for all out-of-band circuits which terminate at the station in question. For those circuits passing through a given station as well as those that terminate using out-of-band circuits signalling the procedure called out for non-standard signalling in para 4.3.3.2 will be employed.

4.1.1.2 The establishment of a low level $\pm$ 6VDC polar interface at the DC mux poses a more difficult problem

since the majority of the existing DC Mux (VFCT) are high level ± 60VDC. Therefore the conversion to low level operation will be limited to locations where one of the following conditions exist: (level station) any new patch cabinets are required in an existing high or when additional or replacement quantities of DC conditioning equipment exceed 50% of the quantity at the site. In either case conversion of the entire station to low level will be accomplished. Otherwise the requirement of para 4.3.4.4 applies, (i.e. high level equipment requirements will be met with equipment which will facilitate later conversion to low level). Fiscal Policy constraints preclude a large scale replacement of VFCTs as part of or in time for MTCIP. Two other alternatives exist, (1) The VFCTs can be internally modified or strapped; or (2) external level converters can be provided. Unless it can be determined that a modification to the VFCTs can be implemented in time or concurrently with the MTCIP installation, individual line level converters shall be programmed.

4.2 Equipment Objectives.

4.2.1 Within the TCF equipment area, the primary objective is to replace any equipment which is either obsolete or unreliable. No single data base is available to assist in this area, therefore, recommendations from the site personnel must be solicited.

4.2.2 An equipment evaluation should be performed to determine if replacement is warranted. The evaluation will include comments on the following:

4.2.2.1 Condition - Each item will be inspected for visible deterioration of wiring and parts.

4.2.2.2 Maintainability - Maintenance personnel will be consulted and records reviewed to determine the extent of maintenance problems encountered in the past and the potential for future maintenance problems.

4.2.2.3 Compatibility - All equipment currently installed that is subject to retention will be analyzed to ensure comparibility with new equipment to be installed.

4.2.2.4 Logistics Supportability - Each piece of equipment will be analyzed to determine whether equipment will be supportable for the expected life of the new installation.

4.2.2.5 Appendix D provides a list of specific equipments which will be replaced in all cases. In addition the rational for selecting these items is provided.

4.3 Technical Requirements.

4.3.1 In addition to the considerations required above, each subsystem and item of equipment must meet certain minimum technical requirements. These requirements are layed out in the remainder of the section.

4.3.1 Patch Panels

4.3.1.1 All jack sets must be compatible with three conductor (tip, ring, sleeve) standard size patch plugs.

4.3.1.2 An Equal Level VF Patch capability must be provided at each location. The Equal Level Patch shall provide the following:

a. All long haul circuits appearing as 4-wire OTLP 600 ohm circuits.

b. Individual transmit and receive jack panels (rather than combined TX and RX).

c. Normal thru tip-ring-sleeve jacks with dual bridge monitor jacks (preferred); or normal thru tip-ring jacks with bridge monitor jack on the line side (minimum requirement).

d. Associated line and equipment jacks appearing in a vertical line.

e. A miscellaneous jack panel providing jack access to such items as 600 ohm resistors, level and noise meters, test tones, etc.

f. An interbay trunk jack panel providing jack access to other patch bays and test bays.

4.3.1.3 A Primary Patch capability must be provided at each location. The Primary Patch shall provide the following:

a. All subscriber and cable system circuits appearing on jacks segregated by subscriber and cable system.

b. Individual transmit and receive jack panels (rather than combined TX and RX).

c. Normal through tip-ring-sleeve jacks with dual bridge monitor jacks (preferred); or normal thru tip-ring jacks with bridge monitor jack on line jack (minimum requirement).

d. Associated line and equipment jacks appearing in a vertical line.

e. A miscellaneous jack panel providing jack access to such items as 600 ohm resistors, level and noise meters, test tones, etc.

f. An interbay trunk jack panel providing jack access to other patch bays and test bays.

4.3.1.4 A DC Circuit Patch must be provided at each location controlling DC circuits. The DC Circuit Patch shall provide the following:

a. All long haul circuits appearing as either all low level polar signalling or all high level polar signalling.

b. Individual transmit and receive jack panels (rather than combined TX and RX).

c. Normal through jack logic between line and equipment in a vertical alignment.

d. Shunt type high impedance monitor jacks for line and equipment for low level patching.

e. Series type monitor jacks for high level patching.

f. A miscellaneous jack panel providing jack access to such items as level meters, mark bettery, space battery, terminating resistor, etc.

g. An interbay trunk jack panel providing jack access to other patch bays and test bays.

4.3.1.5 A DC Primary Patch must be provided at each location controlling DC circuits. The Primary Patch shall provide the same features as the VF Primary Patch (para 4.3.1.3) except for the miscellaneous jack panel which shall provide the features of the DC Circuit Patch miscellaneous patch (para 4.3.1.4f).

4.3.1.6 An FDM group patch must be provided at each location. The group patch shall provide the following:

a. All FDM groups appearing on normal through jacks with bridge monitoring.

b. Access to wideband test equipment for monitoring and testing.

4.3.1.7 No requirement exists for supergroup patch appearances within the tech control.

4.3.1.8 An FDM baseband monitoring capability is required within each tech control.

4.3.2 VF Conditioning and Signalling Equipment.

4.3.2.1 Level adjustment equipment must be provided to allow OTLP interface at the Equal Level Patch. (Echo

Suppressors and Single Frequency Signalling Units are TLP dependent and must be considered when establishing a OTLP point).

4.3.2.2 Each circuit using nonstandard signalling will be provided with a 2600 Hz Single Frequency Signalling Unit and either a ringdown converter or dial loop converter. (NOTE: These units may not be usable until the distant end is converted to standard signalling, however the equipment shall be provided).

4.3.2.3 Circuits using nonstandard signalling should be identified and included in the SCL. For circuits terminating at non-Air Force sites a request to the responsible agency through channels should be initiated by the O&M unit for conversion to standard signalling for the distant end. This request should be initiated as soon as a firm ISD has been established for that site.

4.3.2.4 Adequate amplitude and delay equalization equipment must be provided to allow equalization of all circuits to the specified DCA parameter code (e.g. S1, S2, S3).

4.3.2.4.1 Bulk amplitude equalizers, utilizing slope equalization, for high and low frequencies are designed primarily for application to long wire lines. More complex amplitude and delay equalizers utilizing multiple sections across the frequency band (typically 12 section)

are designed for application to microwave radio and FDM derived channels.

4.3.2.4.2 An example of an equalizer which does not meet present day operational requirements is the Stelma DE-3B delay equalizer. This item has no provision for amplitude equalization and therefore many long circuits cannot be equalized properly.

4.3.2.5 Echo suppression is required only on those circuits which so specify in the TSO. However an echo suppressor is extremely level sensitive and must be installed at a specified TLP. In providing a OTLP at the equal level patch, care must be exercised to insure proper interface with echo suppressors. Many existing echo suppressors are designed for operation at +7 TLP Receive and -16 TLP Transmit.

4.3.2.6 Conferencing capability must be provided for all multipoint circuits with a minimum of two bridges per station.

4.3.2.7 All spare VF multiplex channels shall be terminated in 600 .

4.3.2.8 Passive peak limiters must be provided at the OTLP for each VF multiplex channel.

4.3.2.9 Figure 1 of MIL-STD-188-310 depicts standard circuit arrangements to suit various operational requirements. Whenever possible, one of those arrangements

should be used in routing a circuit through the TCF. The objective of this requirement is to standardize circuit types. When new circuits are brought into a TCF or when the TCF is rewired these configurations must be applied.

4.3.2.10 Any of the above equipments with identified operational deficiencies other than those stated should be replaced. An example of such a deficiency are Stelma Model SFSU-2600 single frequency signalling units, where operator complaints of instability and excessive bias adjustments are prevalent. While no specific data is available, the number and type of complaints strongly imply some inherent problem.

4.3.3 DC Conditioning and Signalling Equipment.

4.3.3.1 Line isolation relays or level conversion relays incorporating line isolation must be provided on all customer circuits not utilizing the TCF battery and ground system.

4.3.3.2 Conferencing capability must be provided for all multipoint circuits. This capability must be provided using a device intended for that purpose rather than a nonstandard configuration of individual relays.

4.3.3.3 Regenerative repeaters shall be provided on an as required basis.

4.3.3.4 Any of the above equipments provided for use in a high level facility shall be able to operate low

level as well. This may be accomplished two ways, either by internal strapping options within the equipment or by utilizing external lever converters on inherently low level devices. The purpose of this requirement is to facilitate the later conversion of all data circuits to low level operation.

4.3.4 Alarm System.

4.3.4.1 Display of station alarms shall be at a central location within the TCF operations area and visable from the Reporting and Coordination Position.

4.3.4.2 All necessary alarms must make an appearance at the common alarm display and at the necessary maintenance area.

4.3.4.3 Remote site major alarms from any Control and Fault Alarm Reporting System (CFA) shall appear at the common alarm display. (Note: The CFA master panel is a maintenance responsibility and will be located in the maintenance area).

4.3.5 Analog Test Equipment.

4.3.5.1 A quality assurance test center is required at each site. This test center shall consist of all necessary analog test equipment, rack mounted. in one location. Necessary test equipment is defined as that necessary to perform all DCA required tests and as further defined by Table of Allowances 416 (TA 416).

4.3.5.2 Sufficient interbay trunks from the equal level patch bays shall be provided. These interbay trunks shall use jacks and plugs compatible with other jacks and plugs used at that station.

4.3.5.3 Analog test equipment requirements will be satisfied from one of two sources. Either the site will be provided with a TeleSignal QATC (4 cabinets) or equipment specified on TA 416 will be provided. HQ AFCS/DO will develop a plan for deployment of TeleSignal Quality Assurance Test Centers. This determination will be made after the total number of QATCs available is determined.

4.3.6 DC Test Equipment.

4.3.6.1 DC Test Bay. DC test bays shall be provided on the basis of one test bay for one to four DC patch bays, two test bays for five to eight DC patch bays, etc. The test bays shall be so installed so that no DC patch bay is more than two bays away from a test bay. The DC test bay shall contain the following equipment: Data error rate measuring equipment, digital data analysis equipment, dual trace oscilloscope, interbay trunk jacks, and miscellaneous jacks.

4.3.6.2 Access to independent test message generators must be provided within the DC miscellaneous jack panel.

4.3.7 Orderwire/Intercom.

4.3.7.1 Long range orderwire/intercom requirements will be satisfied via the DCS Orderwire Program. Therefore, only minimal effort will be expended on Orderwire problems. These will be limited to leap-frogging of orderwire equipment when installing a new operations area and possible use of organic assets based on yet to be determined availability.

4.3.7.2 All voice orderwire circuits entering or leaving a DCS station shall appear in the TCF at the equal level patch.

4.3.8 Data Orderwire and Teletypewriter Equipment.

4.3.8.1 The data orderwire circuits and terminating equipments shall be located in the operations area.

4.3.8.2 Monitor teleprinters shall be provided on the basis of one per 25 teleprinter circuits, with a minimum of three teleprinters required in each technical control facility servicing teleprinter circuits.

4.3.9 Station Timing Standard.

4.3.9.1 For the most part any station requiring station timing already has it. Network synchronization plans have not proceeded to the point where it is considered cost effective to provide a timing standard for each TCF. Therefore no addition as timing clocks will be provided.

4.3.10 Power Supplies.

4.3.10.1 Unless site personnel indicate that poor quality

of existing power is causing circuit degradation, the only criteria will be system capacity. The primary quality measures are: (1) noise, ripple and regulation, (2) MTBF, (3) MTTR.

4.3.10.2 Primary AC Power

4.3.10.3 48VDC (Tech Power)*

a. Adequate capacity

b. Other (See 4.3.11.1)

4.3.10.4 130 BDC (DC loop power)*

a. Adequate capacity

b. Other (See 4.3.11.1)

4.3.10.5 60 VDC (DC loop power)*

a. Adequate capacity

b. Other (See 4.3.11.1)

4.3.10.6 6 VDC (DC loop power)*

a. Adequate capacity

b. Other (See 4.3.11.1)

*(Note: Any new power supplies should be sized to replace rather than add to an existing supply).

4.3.11 Reporting and Coordination Position. The reporting and coordinating position shall be located in the technical control in a position that gives visual access to all working positions. The reporting position must be provided access to Administrative PBX and AUTOVON telephone service in order to meet reporting requirements of

the Defense Communications Agency and the O&M Agency as well as the master orderwire panel. In addition this position is the central focal point within the TCF for operational records, reports and external coordination matters. (See Appendix E for specific requirements).

4.3.12 Grounding.

4.3.12.1 The performance history of equipments and subsystems in the facility should be examined to establish, if possible, any relationships which exist between grounding deficiencies and operational problems. If such a relationship is suspected or determined, a more detailed analysis conducted by a specialized team should be recommended to HQ AFCS. Any new installation must establish a proper integrated grounding system in accordance with AFTO 31-10-24, AFCS/EPE TR 75-2 and other appropriate guidance.

4.3.13 Distribution Frames.

4.3.13.1 The evaluation of the distribution frame is intended to assure that the necessary flexibility required in the TCF is provided. In order to provide this flexibility each of the following equipments must be terminated on a distribution frame:

a. All patch panels.

b. All VF and DC conditioning equipment (either individually or string inputs and outputs).

c. All multiplex channels.

d. All VFCT channels.

e. Terminating resistors.

4.3.13.2 All outside plant cable terminations on a distribution frame must be provided with lightning protectors.

5.0 CONCLUSIONS

5.1 If as a result of the foregoing analysis, it is determined that 50% or more of the equipment in a given functional area must be replaced the entire complement of equipment in that functional area should be replaced. Equipment planned for replacement should be considered for installation at some other location requiring additional equipment of that type. The same applies if 50% or more new equipment is to be added for expansion for new programs. In the case of patch bays it is again stressed that all patch bays of a given functional type must be similar and compatible.

5.2 Also as a result of the foregoing analysis a written recommendation as to the magnitude and scope of any upgrade should be provided. That recommendation should specify one of the following:

a. Full upgrade is required and appears justified.

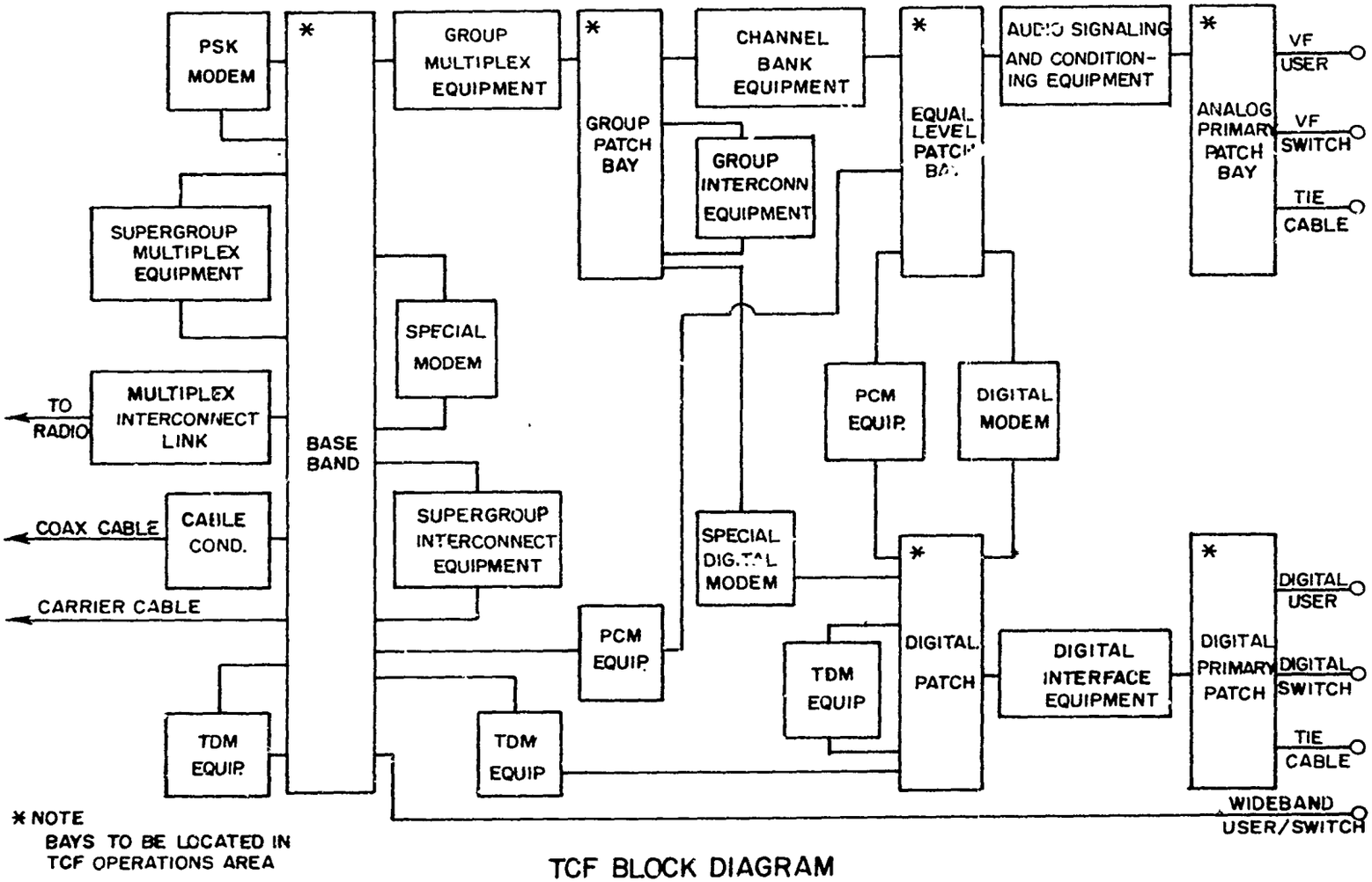
b. Selective upgrade is required and appears justified.

c. Upgrade cannot be justified.

The justification for any recommendation should highlight the major deficiencies at the site involved.

APPENDIX A

TCF BLOCK DIAGRAM



TCF BLOCK DIAGRAM

APPENDIX B

MAJOR ITEMS LIST BY SUBSYSTEM

MAJOR ITEM LIST BY SUBSYSTEM

A. VF Signalling & Conditioning

1. Pulse Link Repeater
2. EM/20 Hz Converter
3. Dial Loop/EM Conv, (Subs)
4. Dial Loop/EM Conv, (C.O.)
5. 4 W. Term Set-Repeat Coil
6. 6 W-4 W. Bridge
7. Single Frequency Signalling Unit
8. Line Amp
9. Pad
10. Amplitude Equalizer
11. Delay Equalizer
12. Auto Ringdown Converter
13. Echo Suppressor
14. Passive Peak Limiters
15. 20 Hz Signalling Supply
16. 2600 Signalling Supply
17. DX Units

B. VF Circuit Patch Cabinet

1. Cabinet
2. Patch Modules
3. Miscellaneous Jack Module
4. Interbay Trunk Module
5. Level Noise Meter (optional)

6. Test Tone Source

7. Monitor Speaker

C. VF Primary Patch Cabinet

1. Cabinet

2. Patch Modules

3. Miscellaneous Jack Module

4. Interbay Trunk Module

5. Level Meter (Optional)

6. Multimeter (Optional)

D. Cable Test Cabinet

1. Interbay Trunk Module

2. Cabinet

3. TA 416 Equipment

4. Test Equipment Access Module

E. DC Circuit Patch

1. Equipment Cabinet

2. DC Patch Modules Send

3. DC Patch Modules Receive

4. Interbay Trunk Module

5. Miscellaneous Jack Module

6. DC Voltmeter Panel 10 VDC

7. DC Voltmeter Panel 100 VDC

F. DC Primary Patch

1. Cabinets

2. Patch Modules

3. Miscellaneous Jack Module

4. Interbay Trunk Module

5. Digital Multimeter (option)

6. Panel Meter (option)

G. DC Test Bay

1. Interbay Trunk Modules

2. Test Equipment Access Module

3. Test Equipment

H. DC Circuit Conditioning

1. Level Converters/Isolaters

2. Regen. Repeater

3. Loop Pots

4. Hubbing Repeaters

5. Pattern Generator

6. Digital Multiplier

I. QATC

1. Interbay Trunk Module

2. Cabinet(s)

3. TA 416 Equipment (or equivalent)

4. Test Equipment Access Module

J. UPS

1. Rectifiers

2. Inverters

3. Battery Banks

4. Control Unit-Regulator

5. Distribution Panels (DC)

48 VDC Power Supply

1. Redundant Power Supplies

2. Control Unit-Regulator

3. Distribution Panels

K. Alarm System

1. Common Alarm Units

2. Remote Alarm Display

L. 6 VDC Power Supply/Distr System

1. Redundancy-Automatic Changeover

2. Alarm and Monitor System (meters)

3. Distribution

M. 60 VDC Power Supply/Distr System

1. Redundance-Automatic Changeover

2. Alarm and Monitor System (meters)

3. Distribution

N. 130 VDC Power Supply/Distr System

1. Redundance-Automatic Changeover

2. Alarm and Monitor System (meters)

3. Distribution

O. Coordinating and Reporting Position

1. Orderwire Master Panel

2. Administrative Telephone

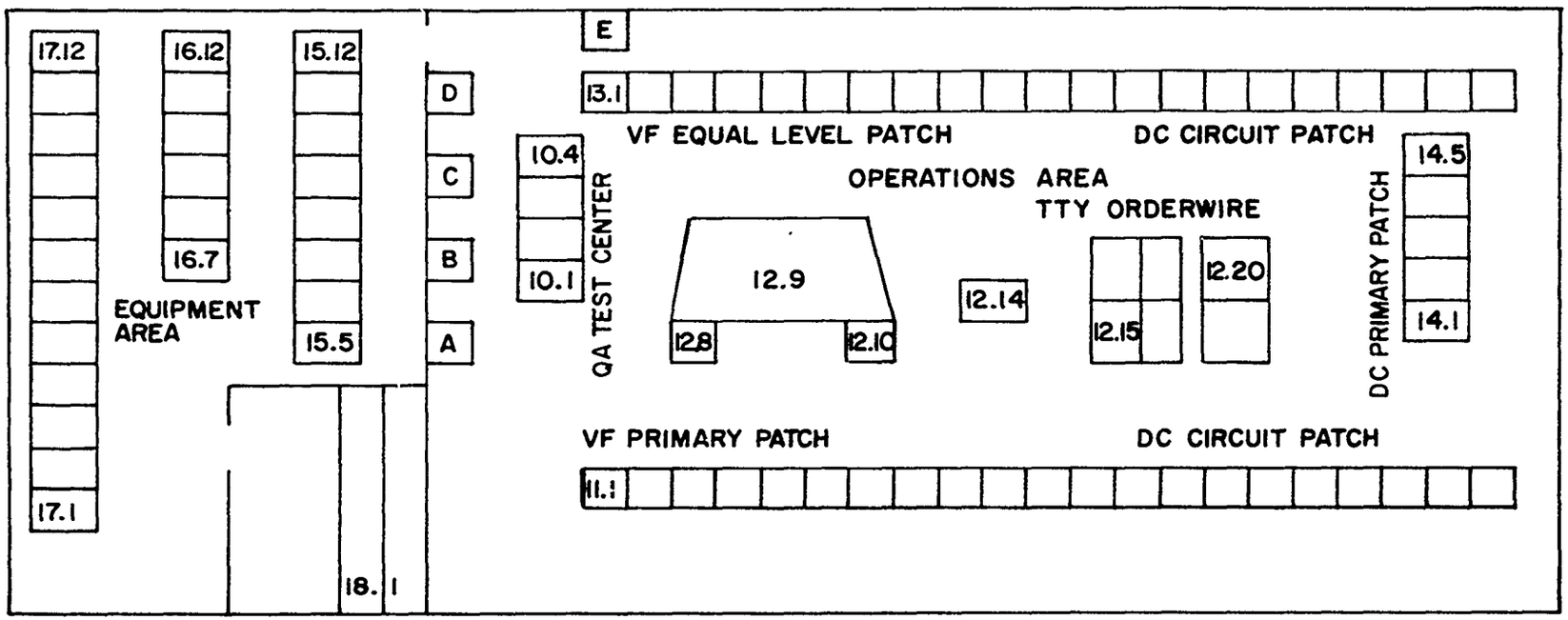
3. AUTOVON Telephone

MAJOR ITEMS ELIMINATED FROM CONSIDERATION FOR PHASE II PURCHASE

	ITEM	REASON FOR ELIMINATION
1.	QATC	Sufficient quantity already supplied in STS inventory and TA 416 Authorizations.
2.	Misc. VF-Bay Test Equip	Sufficient quantity already supplied in STS inventory and TA Authorizations.
3.	Cable Test Equip	Sufficient quantity already supplied in STS inventory and TA 416 Authorizations.
4.	Voice Recorder (for order wire recording)	No Operational Requirement
5.	Digital Readout Clock	Operational Requirement will be satisfied by other means.
6.	Signal Timing Clock	Present Systems requiring timing already have master clock; no new operational requirements foreseen.
7.	On-Line Monitor	Duplicates ATEC DDMS (Digital Distortion Monitor Subsystem)
8.	IC/OW	Duplicates DCS IC/OW Program
9.	VIP Switches	No new requirement; unique requirements satisfied through NCA scheme action.
10.	Control & Fault Alarm	Duplicates ATEC MTU (Monitor Telemetry Unit)
11.	Pilot Make Busy	Duplicates Dual Tone SF Unit

APPENDIX C

STANDARD FACILITY FLOOR PLAN



STANDARD FACILITY FLOOR PLAN

ITEM NO	DESCRIPTION
10.1	AUDIO AQ TEST CENTER BAY 1
10.2	AUDIO QA TEST CENTER BAY 2
10.3	AUDIO QA TEST CENTER BAY 3
10.4	AUDIO QA TEST CENTER BAY 4
11.1	WIDEBAND PATCH BAY
11.2	WIDEBAND PATCH BAY
11.3	PRIMARY PATCH BAY (VF)
11.4	PRIMARY PATCH BAY (VF)
11.5	PRIMARY PATCH BAY (VF)
11.6	PRIMARY PATCH BAY (VF)
11.7	PRIMARY PATCH BAY (VF)
11.8	PRIMARY PATCH BAY (VF)
11.9	PRIMARY PATCH BAY (VF)
11.10	CABLE TEST BAY
11.11	EXPANSION
11.12	EXPANSION
11.13	EXPANSION
11.14	EXPANSION
11.15	EXPANSION
11.16	6VDC DISTRIBUTION
11.17	CIRCUIT PATCH BAY (DC)
11.18	CIRCUIT PATCH BAY (DC)
11.19	DC TEST BAY
11.20	CIRCUIT PATCH BAY (DC)
11.21	CIRCUIT PATCH BAY (DC)
12.8	REPORTING TELETYPEWRITER
12.9	REPORTING POSITION CONSOLE
12.10	REPORTING TELETYPEWRITER
12.14	RED PATCH BAY
12.15	TELETYPEWRITER ORDERWIRE (RED)
12.16	TELETYPEWRITER ORDERWIRE (RED)
12.17	TELETYPEWRITER ORDERWIRE (RED)
12.18	TELETYPEWRITER ORDERWIRE (RED)
12.19	TELETYPEWRITER ORDERWIRE (BLACK)
12.20	TELETYPEWRITER ORDERWIRE (BLACK)
13.1	INTERMEDIATE DISTRIBUTION FRAME
13.2	INTERMEDIATE DISTRIBUTION FRAME
13.3	CIRCUIT PATCH BAY (VF)
13.4	CIRCUIT PATCH BAY (VF)
13.5	CIRCUIT PATCH BAY (VF)

STANDARD FACILITY
FLOOR PLAN
EQUIPMENT LEGEND

13.6	CIRCUIT PATCH BAY (VF)
13.7	CIRCUIT PATCH BAY (VF)
13.8	CIRCUIT PATCH BAY (VF)
13.9	CIRCUIT PATCH BAY (VF)
13.10	CIRCUIT PATCH BAY (VF)
13.11	CIRCUIT PATCH BAY (VF)
13.12	CIRCUIT PATCH BAY (VF)
13.13	EXPANSION
13.14	INTERMEDIATE DISTRIBUTION FRAME
13.15	STATION COMMON ALARM
13.16	6VDC DISTRIBUTION
13.17	ON-LINE MONITOR BAY
13.18	CIRCUIT PATCH BAY (DC)
13.19	CIRCUIT PATCH BAY (DC)
13.20	DC TEST BAY
13.21	CIRCUIT PATCH BAY (DC)
14.1	LOOP POWER SUPPLY
14.2	PRIMARY PATCH BAY (DC)
14.3	DC TEST BAY
14.4	PRIMARY PATCH BAY (DC)
14.5	INTERMEDIATE DISTRIBUTION FRAME
15.5	48V RECTIFIER
15.6	48V RECTIFIER
15.7	RECTIFIER CONTROL BAY
15.8	INVERTER
15.9	INVERTER
15.10	INTERMEDIATE DISTRIBUTION FRAME
15.11	EXPANSION
15.12	MAIN DISTRIBUTION FRAME
16.7	INTERCOM/ORDERWIRE CONT. BAY
16.8	INTERCOM/ORDERWIRE CONT. BAY
16.9	20 HZ SIGNALLING SUPPLY
16.10	STATION SIGNAL TIMING CLOCK
16.11	EXPANSION
16.12	STATION 6 VOLT POWER SUPPLY
17.1	AUDIO SIGNALLING & CONDITIONING
17.2	AUDIO SIGNALLING & CONDITIONING
17.3	AUDIO SIGNALLING & CONDITIONING
17.4	AUDIO SIGNALLING & CONDITIONING
17.5	AUDIO SIGNALLING & CONDITIONING
17.6	AUDIO SIGNALLING & CONDITIONING
17.7	AUDIO SIGNALLING & CONDITIONING
17.8	EXPANSION

STANDARD FACILITY
FLOOR PLAN
EQUIPMENT LEGEND
(CONT)

17.9	EXPANSION
17.10	DC CONDITIONING
17.11	DC CONDITIONING
17.12	DC CONDITIONING
18.1	48V STATION BATTERY CELLS
A.	AC TECH PWR PANEL WITH 42EA 20AMP BKRS
B.	AC TECH PWR PANEL WITH 30EA 20AMP BKRS
C.	DC TECH PWR PANEL WITH 42EA 20AMP BKRS
D.	DC TECH PWR PANEL WITH 30EA 20AMP BKRS
E.	AC UTILITY PWR PANEL WITH 24EA 20AMP BK

APPENDIX D

EQUIPMENT REPLACEMENT LIST

EQUIPMENT REPLACEMENT LIST

1. VF patch bay REL 13P62A installed at Bann RRL. Parts and technical data are extremely limited, and design factors (push button insertion of 1 or 2 neper pads) have contributed to excessive circuit dropouts. See attached ECA/LG message, 190830Z Jan 76, para 2A.

2. All AUTOVON patch panels should be considered for replacement due to the difficulty in servicing the existing patch. The wiring and jack installation configurations make access for cleaning and servicing difficult. MTCIP procurement should consider modularized patch facilities. The European AUTOVON Survey Team Final Report, 22 Dec 1975, page N-XMSN-3-1 addresses the deterioration of patch panels, i.e., lost tension of springs in jacks, broken plastic lock caps, continuity problems.

3. Stelma 2600 SFSUs be replaced. Although quantitative data is not available to support this recommendation to replace the Stelma, all experienced personnel contacted agreed that it is a high manhour consumer and should be replaced. ECA/LG message para 2C.

4. Stelma delay equalizers, Stelma DC-3B should be considered for replacement. The European AUTOVON Survey Team Final Report, 22 Dec 75, page I-SW-13-1, indicates that these units require frequent critical adjustment.

5. Also recommend that two other equipment items be considered for replacement under MTCIP, the CV566 and TA182/U ringers. Although these items are supportable they are designed for tactical use versus fixed use. They have high power consumption, and they use a non-standard ringing frequency (1600 Hz instead of 2600 Hz). See ECA/LG message para 2C and para 4.1.1.1 of this document.

ROUTINE 170

RTTEZYUW RUDOECA2869 0191211-EEEE--RUKTAAA.
ZNY EEEEE
R 190830Z JAN 76
FM ECA LINDSEY AS GE/LG
TO AFCS RICHARDS GEBAUR AFB MO/LG
BT
UNCLAS E F T O
SUBJ: MANUAL TECHNICAL CONTROL IMPROVEMENT PROGRAM (MTCIPO
1. REF. A. AFCS LG 262200Z NOV 75
B. AFCS LG 062137Z JAN 75
2. FOLLOWING CONSTITUTES OBSERVATIONS NOTED BY ECA LG REPRESENTATIVE DURING SUBJECT TDY.
A. THE ONLY EQUIPMENT IDENTIFIED WHICH COULD BE CATEGORIZED AS NO LONGER LOGISTICALLY SUPPORTABLE WAS THE VF PATCH BAY REL 13P62A INSTALLED AT BANN RRL. PARTS AND TECHNICAL DATA RE EXTREMELY LIMITED AND DESIGN FACTORS (PUSH BUTTON INSERTION OF 1 OR 2 NEPER PADS) HAVE BEEN NOTED BY PREVIOUS FEIC VISITS AS CONTRIBUTING TO EXCESSIVE CIRCUIT DROPOUTS. STRONGLY RECOMMENDED REPLACEMENT BE GIVEN EARLY CONSIDERATION UNDER MTCIP.
B. ALL REMAINING PATCH PANELS CAN BE MAINTAINED AND LOGISTIC SUPPORT PROBLEMS (TECHNICAL DATA OR PARTS) WERE NOT NOTED. CONCERN WAS EXPRESSED REGARDING THE DIFFICULITY IN SERVICING ALL EXISTING

PATCH PANELS. PRIMARILY, WIRING AND METHOD IN JACK INSTALLATIONS MAKE IT DIFFICULT TO ACCESS SAME TO CLEAN CONTACTS CAUSING SOME DISRUPTION OF SERVICE ON ADJACENT JACKS. MTCIP EQUIPMENT PROCUREMENT SHOULD CONSIDER MODULAR DESIGN TECHNIQUES WHICH WOULD PERMIT PERIODIC CHANGE OUT.
C. THE STELMA 2600SFU IS PROBABLY THE HIGHEST MANHOUR CONSUMER OF ALL TCF CONDITIONING EQUIPMENT AND IS EXPECTED TO INCREASE WITH THE ADOPTION OF MORE ON SITE REPAIR OF SAME VERSUS TURNAROUND TO THE CIMF. ONLY TWO OTHER EQUIPMENT ITEMS WERE CONSIDERED FOR REPLACEMENT, THE CV566 AND TA182/U RINGERS. MAINTENANCE PERSONNEL STATE BOTH ARE MAINTAINABLE AND PARTS SUPPORT ADEQUATE BUT GENERALLY DISLIKE THE UNITS. REPLACEMENT UNDER MTCIP SHOULD BE PURSUED.
3. ONE AREA THAT DOES NOT RELATE TO LOGISTICS SUPPORTABILITY BUT NECESSITATES UNDUE WIRING AND EXPENDITURE OF MANHOURS IS THE MANNER IN WHICH THE CIRCUIT CONDITIONING STRING IS ESTABLISHED. AT PRESENT ALL CONDITIONING EQUIPMENT APPEARANCE ARE ROUTED TO THE MDF/IDF AND CROSS CONNECTED AS NEEDED TO ACHIEVE THE DESIRED CONFIGURATION.

MESSAGE ROUTING INDICATOR																								
AGENCY	AC	CC	CS	CSS	DA	DE	DO	DP	EP	FF	HC	HO	IG	JA	LG	OA	OI	SG	XP	IGE	CSB	DDOI	COMM CEN	DECR DOCN
ACTION															4									
INFO		4																						

AFCS HQ FORM 0-71, AUG 74 PREVIOUS EDITIONS WILL BE USED.

THIS TECHNIQUE REQULTS IN EXCESSIVE CABLE RUNS TO THE MDF/IDF AND MAY RESULT IN INCREASED CIRCUIT NOISE. ADOPTIONOF A CONDITIONING SET
PAGE 3 RUDOECA2869 UNCLAS E F T O
CONCEPT WHERE ALL COMPONENTS ARE MOUNTED ON A SET BASIS WOULD REDUCE CABLE RUNS, MDF/IDF SIZE AND SIMPLIFY CIRCUIT CONDITIONING ACTIONS.
4. A REDUCTION IN MAINTENANCE MANHOURS AND CIRCUIT CABLING CAN BE ACHIEVED AT SELECTED AUTOVON SITES IF THE -2TLP PATCH REQUIREMENT WERE CHANGED TO A ODBM TLP. THIS ACTION WOULD BE IN LINE WITH THE CRITERIA SET FORTH IN MIL STD 188-310 AND PROBABLY REDUCE THE EQUIPMENT REQUIREMENTS IN FUTURE MTCIP UPGRADE EFFORTS. THE CHANGE TO A OTLP FOR AUTOVON SHOULD BE ADOPTED AS SOON AS POSSIBLE TO MAKE AVAILABLE ADDITIONAL JACK APPEARANCES UNTIL FINALIZATION OF MTCIP. WE SOLICIT YOUR SUPPORT IN OBTAINING AUTHORIZATION TO IMPLEMENT THIS CHANGE.
BT
#2869
NNNN
R 0191406 ACK

PATCH PANEL DETERIORATION

PROBLEM: Deterioration of patch panel jacks in tech control facilities at some AUTOVON sites.

FINDINGS:

After the installation of the patch panels in use at Hillingdon and Martlesham Heath, continuity problems have been encountered within the jack fields.

a. The tension springs have lost some tension and do not always make contact with the contact points. The continuity problem was originally thought to be caused by dust and oxidation between the contact and tension spring. Amazon contact cleaner was sprayed to clean the jacks. Over the years this has caused a glaze to form on the spring and contact. As the spring tension changed, the contacts eventually started to make contact with different points on the spring. The contact glaze being non-conductive caused either a high resistance or loss of signal, resulting in circuit outage.

b. The plastic lock caps used to hold the jack to the patch panel face becomes brittle and breaks very easily when a jack is inserted into the jack field, causing wires to break in the jacks.

RECOMMENDATIONS:

ECA and 5th Signal Command initiate action to replace or upgrade as appropriate AUTOVON tech control patch panels with defective/deteriorated components.

STELMA DELAY EQUALIZER MAINTENANCE

PROBLEM: Stelma delay equalizers are unsatisfactory from a maintenance point of view.

FINDINGS:

Maintenance adjustments to Stelma delay equalizers (Stelma Part Number DE-3B) are too critical and require adjustments too often. For example, it was noted that:

a. Tab locking nut for delay adjustment must remain loose on some units to remain in tolerance.

b. Positioning of the in and out switch to the out position forces realignment of the unit.

c. Switches on the Stelma units are noisy.

RECOMMENDATION:

ECA and 5th Signal Command require subordinate elements to initiate quality unsatisfactory material reports in accordance with TO 00-35D-44.

APPENDIX E

REPORTING COORDINATING POSITION

REPORTING COORDINATING POSITION

1. The present coordination positions in the existing technical controls are locally fabricated or military desks with "homemade" modifications. This non-standard fabrication causes an additional workload on technical control personnel since a standard centralized position is not provided to preform all required functions and responsibilities. As currently existing, actions that should be preformed from a central position within the technical control are scattered throughout the facility and have to be accomplished by additional personnel. A coordination position must be established to provide the centralized management functions required, such as:

a. Maintaining daily operational records and logs.

b. DCA/AFCS reporting requirements.

c. Internal/external coordination matters.

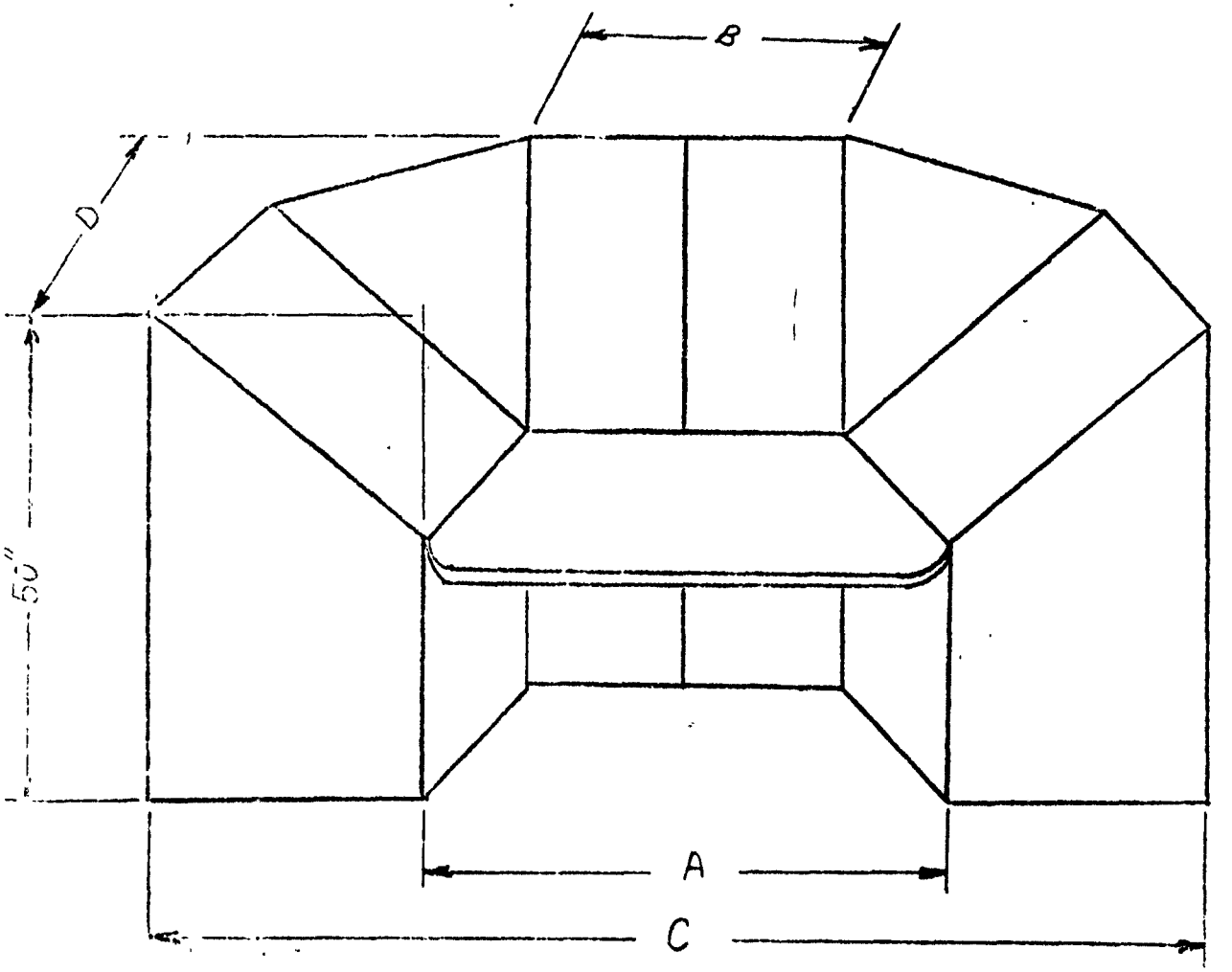
d. Maintenance work orders.

e. Coordinating trouble reports from/to all users.

f. Providing a central area for real-time status of transmission lines, supergroups, groups, channels, circuits and communications equipment under the TCF supervision.

2. In addition, this would also house the master orderwire control panel where the status of and access to all intercom, orderwires, AUTOVON and base PBX circuits are provided.

3. The attached drawing depicts typical arrangement.



DIMENSIONS:

	CENTER CAB. Q'TY. 1	2	3
A	54 5/8"	73 7/16"	92 3/4"
B	19 1/16"	33 1/8"	57 5/16"
C	83 3/8"	102 13/16"	121 1/2"
D	46 3/4"	46 3/4"	46 3/4"

TYPICAL CONSOLE

APPENDIX F

BIBLIOGRAPHY

Bibliography

Mil Std 188-100	Common Long Haul and Tactical Communications System Technical Standards
Mil Std 188-310	Subsystem Design and Engineering Standards for Technical Control Facilities
DCAC 310-50-6	Defense Communications System Orderwire Concept
DCAC 310-70-1	DCS Technical Control
DCAC 310-70-1	Supplement 1 Volume II Procedures Test Descriptions
AFCSR 500-42	Operational Policy for Orderwire/Intercom Systems
AFCS/EPE TR75-2	AFCS Technical Report on Grounding Systems
AFTO 31-10-24	Theory, Principals, and Practices of Grounding Procedures and Lightning Protection for C-E Equipment, Facilities and Systems